

Amendments To The Claims

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1 (currently amended): An irrigation controller for controlling the operation of an irrigation system having valves and sensors, said controller comprising:

a controller housing having a front cover door and a rear cabinet portion;

a base unit mounted within said housing and including a control panel removably mounted to the rear cabinet portion and a back plane circuit board [[permanently]] mounted to the rear cabinet portion and releasably connected with said control panel, said back plane circuit board including a plurality of discrete electrical output connector sets communicating with said first microcontroller, said removable control panel including a first microcontroller for sending control signals to said back plane circuit and capable of receiving and storing irrigation system programs input into said first microcontroller;

a base module removably mounted within said rear cabinet portion and electrically coupled with said back plane circuit board through one of said plurality of output discrete electrical output connector sets, said base module including drivers and output switches for actuating irrigation valves in accordance with control signals received from said first microcontroller; and

an expansion module removably mounted within said rear cabinet portion and electrically coupled with said back plane circuit board through another of said plurality of discrete electrical output connector sets, said expansion module including a second microcontroller capable of communicating with said first microcontroller, and drivers and output switches coupled with said second microcontroller for actuating irrigation system valves, said first and second microcontrollers operating together in order to carry out irrigation system operations not capable of being performed by said first microcontroller alone,

wherein the other of said plurality of discrete electrical output connector sets to which the expansion module is electrically coupled may be any one of said plurality of discrete electrical output connector sets capable of being coupled to a given expansion module independent of the

electrical coupling of another expansion module to another of said plurality of discrete electrical output connector sets.

Claim 2 (original): An irrigation controller as set forth in Claim 1 wherein the controller includes a plurality of said expansion modules removably mounted within said rear cabinet portion, each of said modules including said second microcontroller for operating with said first microcontroller.

Claim 3 (currently amended): An irrigation controller as set forth in Claim 1 including a smart module removably mounted within said rear housing portion and electrically coupled with said back plane circuit board through a third one of said plurality of output discrete electrical output connector sets, said smart module having a third microcontroller capable of communicating with said first microcontroller and operating together with said first microcontroller to control the operation of a variety of irrigation functions ~~contained in the first microcontroller program~~ that can not be performed by said base module and said expansion module.

Claim 4 (original): An irrigation controller as set forth in Claim 1 wherein said control panel includes operational controls and indicators for permitting a user to input irrigation program information into said first microcontroller; and

a battery coupled with said first microcontroller to provide electrical power to said first microcontroller when said control panel is removed from said housing, whereby said control panel can be completely removed from said housing and taken to a remote location for inputting and storing irrigation program information into said microcontroller through said operational controls.

Claim 5 (original): An irrigation controller as set forth in Claim 4 wherein said control panel includes a recess for removably receiving said battery, said battery being retained in said recess by a cantilever-type spring mounted to the control panel and releasably biasing against

said battery.

Claim 6 (original): An irrigation controller as set forth in Claim 5 wherein said front cover door is pivotally connected to said rear cabinet portion such that when said door is closed, said door encloses said cabinet portion but can be opened to gain access to the cabinet interior, said door including a light pipe through which a visual identification of the controller status can be observed when said door is in the closed position.

Claim 7 (original): An irrigation controller as set forth in Claim 2 wherein each of said plurality of expansion modules has a pin-out electrical connection pattern with said back plane circuit board comprising: 1- EARTH GROUND; 2- AC COM; 3- AC HOT; and 4 – COMM “X” where “X” is the particular one of said plurality of back plane circuit board connector pin sets to which the particular expansion module is coupled.

Claim 8 (currently amended): A modular irrigation controller for controlling the operation of an irrigation system having valves, sensors, and the like, said controller comprising:

a controller protective housing;

a base unit mounted within said housing and including a control panel removably mounted to the housing and a back plane circuit board [[permanently]] mounted in the housing, said control panel including a releasable connection to said back plane circuit board and including a first microprocessor for sending control signals to said back plane circuit, said back plane circuit board including a plurality of module receiving locations each having a discrete output connector set for communicating between said first microcontroller and a module connected thereto;

a base module removably mounted within said housing at a first one of the plurality of module receiving locations and electrically coupled with said back plane circuit board, said base module including drivers and output switches for actuating irrigation valves in accordance with control signals received from said first microcontroller; and

at least one expansion module removably mounted within said housing at a respective

one of the plurality of module receiving locations other than the first one and electrically coupled with said back plane circuit board, said expansion module including a second microcontroller capable of communicating with said first microcontroller, and a plurality of drivers and output switches coupled with said second microcontroller for actuating irrigation system valves, said first and second microcontrollers operating together to control the operation of an irrigation system,

wherein each expansion module may be mounted to any one of the plurality of module receiving locations other than the first one independent of the mounting of another expansion module to another of the plurality of the module receiving locations.

Claim 9 (currently amended): An irrigation controller as set forth in Claim 8 wherein each of said plurality of module receiving locations of said back plane circuit board includes one of a plurality of discrete output connector sets for transmitting signals from said first microcontroller, said base module being removably connected to a first one of said plurality of back plane circuit board output connector sets, and having drivers and output switches for actuating irrigation valves in accordance with control signals received from said first microcontroller.

Claim 10 (original): An irrigation controller as set forth in Claim 9 wherein each of said expansion modules is removably connected with another of said plurality of discrete output connector sets other than said first one, and has a pin-out electrical connection pattern with said back plane circuit board comprising: 1- EARTH GROUND; 2- AC COM; 3- AC HOT; and 4 – COMM “X” where “X” is the particular one of the plurality of output connector sets to which the particular expansion module is coupled.

Claim 11 (currently amended): An irrigation controller as set forth in Claim 8 including a smart module removably mounted within said housing at a respective one of the plurality of module receiving locations other than the first one and having a third microcontroller capable of communicating with said first microcontroller and operating together with said first

microcontroller to independently control the operation of a variety of irrigation functions ~~contained in the first microcontroller program~~ that can not be performed by said base module and said expansion module.

Claim 12 (currently amended): An irrigation controller as set forth in Claim 11 wherein each of said plurality of module receiving locations of said back plane circuit board includes one of a plurality of discrete output connector sets for transmitting signals from said first microcontroller, said base module being removably connected to a first one of said plurality of back plane circuit board output connector sets, and having drivers and output switches for actuating irrigation valves in accordance with control signals received from said first microcontroller.

Claim 13 (original): An irrigation controller as set forth in Claim 12 wherein each of said expansion modules is removably connected with another of said plurality of discrete output connector sets other than said first one, and has a pin-out electrical connection pattern with said back plane circuit board comprising: 1- EARTH GROUND; 2- AC COM; 3- AC HOT; and 4 – COMM “X” where “X” is the particular one of the plurality of output connector sets to which the particular expansion module is coupled.

Claim 14 (original): An irrigation controller as set forth in Claim 13 wherein said smart module is removably connected with still another of said plurality of discrete output connector sets other than said first and said another of said sets to which an expansion module is connected, and said smart module has a pin-out electrical connection pattern comprising: 1 - EARTH GROUND; 2 - AC COM; 3 - AC HOT; and 4 - COMM X; and 5 - COMM 4.

Claim 15 (original): An irrigation controller as set forth in Claim 8 wherein said control panel includes operational controls and indicators for permitting a user to input irrigation program information into said first microcontroller; and
a battery coupled with said first microcontroller to provide electrical power to said first

microcontroller when said control panel is removed from said housing, whereby said control panel can be completely removed from said housing and taken to a remote location for inputting and storing irrigation program information into said microcontroller through said operational controls.

Claims 16-31 (canceled)

Claim 32 (currently amended): In an irrigation controller of the type including a central controller unit housed within a protective housing and having a programmable base microcontroller within the housing for receiving and storing irrigation program schedules, and at least one expansion module assembly removably mounted within the housing and coupled with the base microcontroller and with a plurality of remote irrigation function operators such as valves, sensors, and the like, each expansion module assembly mounted to a respective one of a plurality of module receiving locations, the improvement wherein said at least one module assembly includes a second internal microcontroller communicating with said base microcontroller and operable therewith to effect execution of irrigation program functions not capable of being executed by said base microcontroller alone and wherein each expansion module assembly may be mounted to any one of the plurality of module receiving locations independent of the mounting of another expansion module assembly to another of the plurality of the module receiving locations.

Claim 33 (original): The improvement as defined in Claim 32 wherein said expansion module assembly includes a generally rectangular shaped body having front and rear ends separated by top and bottom surfaces, said front end portion carrying a set of exposed electrical connectors, and said rear end portion having output connection terminals thereon for connection to external irrigation system valves, sensors and the like, and releasable means carried by said body for coupling and retaining said module in an operative position within said protective housing with said electrical connectors on said front end portion electrically coupled to said base microcontroller.

Claim 34 (currently amended): The improvement as set forth in Claim 33 wherein said base microcontroller is coupled to a back plane circuit board mounted in said protective housing, said back plane circuit board having a plurality of discrete output connector sets for transmitting signals from said first microcontroller to said set of exposed electrical connectors of said expansion module when said module is in said operative position, each of said plurality of discrete output connector sets located at a respective one of said plurality of module receiving locations.

Claim 35 (currently amended): The improvement as set forth in Claim 34 wherein said means for coupling and retaining said [[said]] expansion module in said operative position comprises a lever pivotally mounted to the top surface of said body, said lever having a locking tab that can be moved by pivoting said lever into and out of abutting engagement with a shoulder formed on a portion of said housing.

Claim 36 (new): The irrigation controller of claim 1 wherein each of said plurality of discrete electrical output connector sets provides an independent communication connection to the control panel.

Claim 37 (new): The irrigation controller of claim 36 wherein the independent communication connection comprises a serial communication line.

Claim 38 (new): The irrigation controller of claim 1 wherein the first microcontroller is configured to communicate and operate with the second microcontroller of the expansion module no matter which of said plurality of discrete electrical output connector sets said expansion module is electrically coupled to independent of the electrical coupling of another expansion module to another of said plurality of discrete electrical output connector sets.

Claim 39 (new): The irrigation controller of claim 1 wherein the expansion module may

be electrically coupled and decoupled to said back plane circuit board through the other of said plurality of discrete electrical output connector sets without removing power to the control panel.

Claim 40 (new): The irrigation controller of claim 39 wherein the first microcontroller is configured to handle dynamic electrical connection and electrical disconnection of the expansion module without restarting the control panel.

Claim 41 (new): The irrigation controller of claim 39 wherein each of said plurality of discrete electrical output connector sets provides power and data such that a power circuit connection is established prior to a data circuit connection being established upon the electrical coupling of the expansion module thereto, and

wherein the power circuit connection is terminated after the data circuit connection upon the electrical uncoupling of the expansion module therefrom.

Claim 42 (new): The irrigation controller of claim 8 wherein each expansion module may be electrically coupled and decoupled to said back plane circuit board at said respective one of the plurality of module receiving locations without removing power to the control panel.

Claim 43 (new): The improvement as set forth in Claim 32 wherein each expansion module may be mounted and removed to the respective module coupling location without removing power to the base microcontroller.

Claim 44 (new): An irrigation controller for controlling the operation of an irrigation system having valves and sensors, said controller comprising:

a controller housing having a front cover door and a rear cabinet portion;

a base unit mounted within said housing and including a control panel removably mounted to the rear cabinet portion and a back plane circuit board mounted to the rear cabinet portion and releasably connected with said control panel, said back plane circuit board including a plurality of discrete electrical output connector sets communicating with said first

microcontroller, said removable control panel including a first microcontroller for sending control signals to said back plane circuit and capable of receiving and storing irrigation system programs input into said first microcontroller;

a base module removably mounted within said rear cabinet portion and electrically coupled with said back plane circuit board through one of said plurality of output discrete electrical output connector sets, said base module including drivers and output switches for actuating irrigation valves in accordance with control signals received from said first microcontroller; and

an expansion module removably mounted within said rear cabinet portion and electrically coupled with said back plane circuit board through another of said plurality of discrete electrical output connector sets, said expansion module including a second microcontroller capable of communicating with said first microcontroller, and drivers and output switches coupled with said second microcontroller for actuating irrigation system valves, said first and second microcontrollers operating together in order to carry out irrigation system operations not capable of being performed by said first microcontroller alone,

wherein the expansion module may be electrically coupled and decoupled with said back plane circuit board through the other of said plurality of discrete electrical output connector sets without removing power to the control panel.

Claim 45 (new): The irrigation controller of claim 44 wherein the first microcontroller is configured to handle dynamic electrical connection and electrical disconnection of the expansion module without restarting the control panel.

Claim 46 (new): The irrigation controller of claim 44 wherein each of said plurality of discrete electrical output connector sets provides power and data such that a power circuit connection is established prior to a data circuit connection being established upon the electrical coupling of the expansion module thereto, and

wherein the power circuit connection is terminated after the data circuit connection is terminated upon the electrical uncoupling of the expansion module therefrom.

Claim 47 (new): The irrigation controller of Claim 44 wherein the controller includes a plurality of said expansion modules removably mounted within said rear cabinet portion, each of said modules including said second microcontroller for operating with said first microcontroller.

Claim 48 (new): The irrigation controller of Claim 44 including a smart module removably mounted within said rear housing portion and electrically coupled with said back plane circuit board through a third one of said plurality of output discrete electrical output connector sets, said smart module having a third microcontroller capable of communicating with said first microcontroller and operating together with said first microcontroller to control the operation of a variety of irrigation functions that can not be performed by said base module and said expansion module.

Claim 49 (new): A modular irrigation controller for controlling the operation of an irrigation system having valves, sensors, and the like, said controller comprising:

- a controller protective housing;

- a base unit mounted within said housing and including a control panel removably mounted to the housing and a back plane circuit board mounted in the housing, said control panel including a releasable connection to said back plane circuit board and including a first microprocessor for sending control signals to said back plane circuit, said back plane circuit board including a plurality of module receiving locations each having a discrete output connector set for communicating between said first microcontroller and a module connected thereto;

- a base module removably mounted within said housing at a first one of the plurality of receiving locations and electrically coupled with said back plane circuit board, said base module including drivers and output switches for actuating irrigation valves in accordance with control signals received from said first microcontroller; and

- at least one expansion module removably mounted within said housing at a respective one of the plurality of module receiving locations other than the first one and electrically coupled

with said back plane circuit board, said expansion module including a second microcontroller capable of communicating with said first microcontroller, and a plurality of drivers and output switches coupled with said second microcontroller for actuating irrigation system valves, said first and second microcontrollers operating together to control the operation of an irrigation system,

Claim 50 (new): In an irrigation controller of the type including a central controller unit housed within a protective housing and having a programmable base microcontroller within the housing for receiving and storing irrigation program schedules, and at least one expansion module assembly removably mounted within the housing and coupled with the base microcontroller and with a plurality of remote irrigation function operators such as valves, sensors, and the like, each expansion module assembly mounted to a respective one of a plurality of module receiving locations, the improvement wherein said at least one module assembly includes a second internal microcontroller communicating with said base microcontroller and operable therewith to effect execution of irrigation program functions not capable of being executed by said base microcontroller alone and wherein each expansion module may be mounted and removed to the respective module coupling location without removing power to the base microcontroller.

Claim 51 (new): An irrigation controller comprising:
a housing:
a control unit within the housing, the control unit including a first microcontroller for executing stored irrigation programs;
a plurality of module coupling locations, each electrically coupled with the first microcontroller and adapted to receive one of a plurality of expansion modules; and
an expansion module removably coupled to a respective module coupling location and including a second microcontroller capable of communicating with said first microcontroller and including driver circuitry for actuating irrigation valves, the second microcontroller capable of operating the driver circuitry for actuating said irrigation valves in accordance with control

signals received from the first microcontroller, wherein the respective module coupling location may be any one of the plurality of module coupling locations independent of the coupling of another of the plurality of expansion modules to another of the plurality of module coupling locations.

Claim 52 (new): The irrigation controller of claim 51 wherein each of said plurality of module coupling locations provides an independent communication connection to the control unit.

Claim 53 (new): The irrigation controller of claim 52 wherein the independent communication connection comprises a serial communication line.

Claim 54 (new): The irrigation controller of claim 51 wherein the first microcontroller is configured to communicate and operate with the expansion module no matter which of said plurality of module coupling locations said expansion module is electrically coupled to independent of the coupling of another one of the plurality of expansion modules to another of said plurality of module coupling locations.

Claim 55 (new): The irrigation controller of claim 51 wherein the expansion module may be electrically coupled and decoupled to the respective module coupling location without removing power to the control unit.

Claim 56 (new): The irrigation controller of claim 55 wherein the first microcontroller is configured to handle dynamic electrical connection and electrical disconnection of the expansion module without restarting the control unit.

Claim 57 (new): The irrigation controller of claim 55 wherein each of the plurality of module coupling locations provides power and data such that a power circuit connection is established prior to a data circuit connection being established upon the coupling of the

expansion module thereto, and

wherein the power circuit connection is terminated after the data circuit connection is terminated upon the uncoupling of the expansion module therefrom.

Claim 58 (new): The irrigation controller of claim 55 wherein the expansion module may be electrically coupled and decoupled to the respective module coupling location during operation of the controller.

Claim 59 (new): The irrigation controller of Claim 51 further comprising a smart module removably coupled to another respective module coupling location, said smart module having a third microcontroller capable of communicating with said first microcontroller and operating together with said first microcontroller to control the operation of a variety of irrigation functions that can not be performed by the first module and the expansion module.

Claim 60 (new): An irrigation controller comprising:

a housing:

a control unit within the housing, the control unit including a first microcontroller for executing stored irrigation programs;

a plurality of module coupling locations, each electrically coupled with the first microcontroller and adapted to receive one of a plurality of expansion modules; and

an expansion module removably coupled to a respective module coupling location and including a second microcontroller capable of communicating with said first microcontroller and including driver circuitry for actuating irrigation valves, the second microcontroller capable of operating the driver circuitry for actuating said irrigation valves in accordance with control signals received from the first microcontroller, wherein the expansion module may be electrically coupled and decoupled to the respective module coupling location without removing power to the control unit.

Claim 61 (new): The irrigation controller of claim 60 wherein the first microcontroller is

configured to handle dynamic electrical connection and electrical disconnection of the expansion module without restarting the control unit.

Claim 62 (new): The irrigation controller of claim 60 wherein each of the plurality of module coupling locations provides power and data such that a power circuit connection is established prior to a data circuit connection being established upon the coupling of the expansion module thereto, and

wherein the power circuit connection is terminated after the data circuit connection is terminated upon the uncoupling of the expansion module therefrom.

Claim 63 (new): The irrigation controller of claim 60 wherein the expansion module may be electrically coupled and decoupled to the respective module coupling location during operation of the controller.

Claim 64 (new): The irrigation controller of claim 60 wherein the respective module coupling location may be any one of the plurality of module coupling locations independent of the coupling of another of the plurality of expansion modules to another of the plurality of module coupling locations.

Claim 65 (new): The irrigation controller of Claim 60 further comprising a smart module removably coupled to another respective module coupling location, said smart module having a third microcontroller capable of communicating with said first microcontroller and operating together with said first microcontroller to control the operation of a variety of irrigation functions that can not be performed by the first module and the expansion module.

Claim 66 (currently amended): An irrigation controller for controlling the operation of an irrigation system having valves, sensors and the like, said controller comprising:

a controller housing having a front cover door and a rear cabinet portion;

a base unit mounted within said housing and including a control panel removably

mounted to the rear cabinet portion and a back plane circuit board permanently mounted to the rear cabinet portion and releasably connected with said control panel, said back plane circuit board including a plurality of discrete electrical output connector sets communicating with said first microcontroller, said removable control panel including a first microcontroller for sending control signals to said back plane circuit and capable of receiving and storing irrigation system programs input into said first microcontroller;

a base module removably mounted within said rear cabinet portion and electrically coupled with said back plane circuit board through one of said plurality of output discrete electrical output connector sets, said base module including drivers and output switches for actuating irrigation valves in accordance with control signals received from said first microcontroller;

a plurality of expansion modules, each removably mounted within said rear cabinet portion and electrically coupled with said back plane circuit board through another of said plurality of discrete electrical output connector sets, said expansion module including a second microcontroller capable of communicating with said first microcontroller, and drivers and output switches coupled with said second microcontroller for actuating irrigation system valves, said first and second microcontrollers operating together in order to carry out irrigation system operations not capable of being performed by said first microcontroller alone,

wherein the other of said plurality of discrete electrical output connector sets to which each expansion module is electrically coupled may be any one of said plurality of discrete electrical output connector sets capable of being coupled to a given expansion module independent of the electrical coupling of another expansion module to another of said plurality of discrete electrical output connector sets,

wherein each of said plurality of expansion modules includes a generally rectangular shaped body having front and rear ends separated by top and bottom surfaces, said front end portion carrying a set of exposed electrical connectors for connection to a respective one of said plurality of discrete electrical output connector sets, and said rear end portion having output connection terminals thereon for connection to external irrigation system valves, sensors and the like,

wherein each of said plurality of expansion modules may be electrically coupled and decoupled to said back plane circuit board through the other of said plurality of discrete electrical output connector sets without removing power to the control panel,

wherein each of said plurality of expansion modules has a pin-out electrical connection pattern with said back plane circuit board comprising: 1- EARTH GROUND; 2- AC COM; 3- AC HOT; and 4 – COMM “X” where “X” is the particular one of said plurality of back plane circuit board connector pin sets to which the particular expansion module is coupled,

wherein said control panel includes operational controls and indicators for permitting a user to input irrigation program information into said first microcontroller; and

a battery coupled with said first microcontroller to provide electrical power to said first microcontroller when said control panel is removed from said housing, whereby said control panel can be completely removed from said housing and taken to a remote location for inputting and storing irrigation program information into said microcontroller through said operational controls.